hypothesis of relative motions. Finally, nonshear explanations for observed furrow geometry are considered.

Separations of Poles of Furrow Concentricity

The furrow pole for central Marius Regio (area 3), shown in Figure 7*c*, is near the center of the giant palimpsest in that area's southern portion. The pole's coincidence with the largest observed impactlike feature on Ganymede is good evidence that the palimpsest represented the source of stress for initial furrow formation. The fact that the three other furrow poles are significantly separated from the palimpsest underlines the possibility that à more concentric, impact-related arcuate furrow set may have been disrupted by faulting.

Galileo Regio and Marius Regio. The furrow pole for area 1, Galileo Regio, is to the south and west of both the giant palimpsest and the pole for area 3, central Marius Regio (Figure 7*c*). The component of separation to the south is not statistically significant. This topic of the southward deviation will be addressed again below; it will demonstrated that the southward deviation was probably caused by a systematic deviation of a subpopulation Galileo Regio furrows from concentricity, where their orientations are controlled by older system III furrows.

The furrow pole for area 1 is with >95% confidence to the west the giant palimpsest on which area 3 furrows are centered, and is with 90% confidence to the west of the furrow pole for area 3. The westward separation is in the direction of least uncertainty in the pole position for area 1. The region between areas 1 and 3 is occupied by Uruk Sulcus, a band of light, grooved, and reticulate terrains with a complex deformational history [*Murchie et al.*, 1986], and the direction of most significant pole separation is not dissimilar to the orientation of Uruk Sulcus. It is thus hypothesized (but in no way concluded) that Galileo Regio (area 1) and central Marius Regio (area 3) were offset by approximately 500 km of left-lateral shear across Uruk Sulcus.

The error ellipse for the average pole of area 2, northern Marius Regio, is to the northwest of the pole of area 3, but the separation is in the direction of greatest uncertainty. Additional, unquantified uncertainty in the pole position may result from the very restricted range of furrow orientations in area 2, which could have been influenced by lithospheric inhomogeneities. Furthermore, area 2 consists of small blocks that may have undergone very minor relative motions that altered the furrows' radius of curvature. Finally and most importantly, areas 2 and 3 are structurally continuous and separated by only a single groove (Figure 2*a*). For these reasons, it is concluded that there has been no large relative motion of areas 2 and 3, although very minor motions within area 2 are plausible. A corollary of this is that area 1 may have undergone about 500 km of left-lateral shear relative to area 2 as well as relative to area 3.

Central and southern Marius Regio. Southern Marius Regio, area 4, has a furrow pole significantly to the west of the pole of central Marius Regio (area 3, Figure 7*c*). This separation is parallel to the boundary of areas 3 and 4, and may suggest some amount of right-lateral shear across the intervening area now occupied by light terrain. However, the separation is in the direction of the greatest uncertainty in the position of the pole of area 4. As is the case with area 2, area 4 contains only a restricted range of furrow orientations. Lithospheric inhomogeneities may or may not have dominated furrow curvature, so that all or part of the pole separation may result from minor furrow nonconcentricity in area 4.

Comparison to previous studies. It is critical to note at this point that, had the furrow poles determined by *Schenk and McKinnon* [1987] been used in the above analysis, the same hypothesis of shear deformation could have been posed. The Galileo Regio pole from both studies is offset significantly to the west of the central Marius Regio pole. The furrow pole calculated for southern Marius Regio by Schenk and McKinnon is somewhat to the east of the pole calculated here but is still significantly to the west of the pole for central Marius Regio.

Schenk and McKinnon suggested that the system I arcuate furrows formed in their present configuration and that they are centered on 21°S,179°W (at the star in Figure 7*c*). This pole would yield a good fit for furrows in Galileo Regio but a very poor one for the nearby furrows in Marius Regio (especially the eastern part). One might try to dismiss these latter furrows as merely "incipient grooves," which is not completely unreasonable given that grooves do occur in dark terrain. However, these furrows are not observed to crosscut older craters, so crater densities of large dark terrain areas obtained by S. Murchie et al. (submitted manuscript) disprove the incipient groove hypothesis. The ≥10-km cumulative crater density in central Marius Regio is $340\pm37 \times 10^{-6}$ km^{-2}, similar to that in western Marius Regio ($267\pm27 \times 10^{-6}$ km^{-2}) and Galileo Regio ($248\pm24 \times 10^{-6}$ km^{-2}), and much greater than the crater density of even the oldest observed light terrain (about 150×10^{-6} km^{-2}). These measurements indicate that the furrows in eastern Marius Regio predate even the oldest light terrain and grooved terrain.

Hemispheric Scale Structural Lineaments

The shear deformation hypothesized on the basis of furrow pole separations, if it occurred, could have been accomplished by either or both of two types of faulting. First, major strike-slip movement could have occurred along narrow fracture zones that follow small circle traces. Second, deformation may have been distributed over wide zones, boundaries of which may consist of (1) strike-slip faults or (2) irregular fracture zones across which relatively little movement occurred.

Identification of lineaments that may represent major strike-slip faults or boundaries of zones of distributed shear would support the hypothesis of shear disruption of arcuate furrows, if the orientations, morphologies, and locations of the observed lineaments are consistent with the hypothesized senses of shear offset. The fault or fracture zones should be recognizable if they occur in dark terrain. However, the lack of direct evidence for pervasive shear in large areas of light terrain [*Zuber and Parmentier*, 1984*a*] suggests that any shear offset of the furrows would have predated at least most light grooved terrain. *Murchie et al.* [1986] provided evidence that major, preexisting faults and fracture zones in light terrain were repeatedly reactivated by superposition of throughgoing grooves or groove lanes. In addition, throughgoing fracture zones apparently acted as barriers to propagation of groove sets and thus sometimes separate domains of grooves having distinct orientations. Therefore if major shear faults or fracture zones do exist, they may now be occupied by light grooved terrain, but they still might be recognized as lineaments consisting of (1) abrupt linear discontinuities in regional groove orientation and (2) superposed throughgoing grooves and groove lanes. The lineaments, if identified, are likely locations of any brittle deformation caused by disruption of dark terrain.

Galileo Regio-Marius Regio boundary. Three continuous,